

APPENDIX

The first chart in the package provides some perspective on the association between money and prices. As can be seen from the bars on the left-hand side, on average over the past three decades the money stock and prices have tended to move together. This relationship--often referred to as the long-run neutrality of money--implies that over long periods changes in money only influence the price level and do not permanently affect real variables in the economy. The usual intuition is that if everyone's cash balances were doubled by dropping money from helicopters, the real economy would eventually end up about the same except that prices would be doubled.

But that is eventually. From the point of view of macroeconomic policy, however, the question is how long does it in fact take for the effects of a change in money to be entirely reflected in prices. There is no consensus on the answer to this question. Indeed, assumptions concerning the nature and speed of adjustment are important features differentiating the various theories of inflation. Many rational expectations theorists believe the adjustment is nearly instantaneous; monetarists believe that the adjustment is relatively prompt--perhaps as short as two or three years, while those who use a Phillips curve approach feel that it takes appreciably longer.

The next exhibit summarizes the key features of the view of inflation commonly associated with monetarists. This approach places primary emphasis on the response of inflation to growth of money. Essentially the theory holds that changes in the money stock will lead to stable and predictable short-run movements in nominal spending. Initially an increase

in nominal spending will be reflected in higher output, but over a short period of time increased demand pressures will lead to a bidding up of prices and a return of real output to its long-run growth path. Although some monetarist models--such as that developed several years ago at the St. Louis Bank--spell out this process, the more widely used monetarist approach reduces these relationships to a single equation relating prices to current and past levels of the money stock--with the full impact of money on prices typically being felt within two or three years. Such equations allow little if any role for the state of the business cycle in price determination. The remainder of our briefing will use this so-called "reduced form" money-price relationship in discussing the monetarist analysis of inflation.

The chart in the lower panel shows the relationship between money and prices in the short run. Although the lag between money and prices varies considerably among monetarist equations, a lag of two years is representative of the spirit of these equations. The chart indicates that while money and prices have many times shown a tendency to move together, there often can be substantial short-run differences between inflation and the growth of money. As you can see, the difference has been especially notable since mid-1982.

An alternative approach to analyzing the inflation process involves attempting to trace the structure of linkages in the economy and describe how aggregate demand affects pricing decisions in labor and product markets. As shown in the next diagram, a key analytical feature of most structural views of inflation is the so-called natural rate hypothesis. Essentially, this hypothesis says that there is some

degree of unemployment--determined by the structural characteristics of the economy--that in the long run is associated with stable inflation. Note that the hypothesis refers to a stable rate of inflation, not stable prices. We will address the issue of what factors affect the level of the natural rate of unemployment later in the briefing. Corresponding to this natural rate of unemployment is a level of output--labelled Y_n in the diagram--that will hold unemployment at its natural rate. Attempts to push the economy to levels of output greater than Y_n through expansionary aggregate demand policies lead eventually to accelerating rates of inflation; conversely, holding the economy below Y_n leads to declining inflation.

The process is illustrated in the diagram. The downward sloping lines are aggregate demand schedules and represent the amount of output demanded for a given inflation rate, all other things equal. The upward sloping lines are aggregate supply curves and reflect the amount of labor and capital supplied to the economy at each inflation rate, all other things--particularly expectations--equal. Starting at point A, an increase in aggregate demand, from D_1 to D_2 , will temporarily raise the level of inflation and output, and lower the unemployment rate, producing a short-run tradeoff between inflation and unemployment--point B. But as workers perceive that inflation has increased, their notion of expected inflation will adjust upward. Accordingly, they will demand larger nominal wage increases and the aggregate supply schedule (S_2) will tend to shift up until aggregate supply and demand are equal at the natural level of output, but with a higher inflation rate--point C. The rate of inflation where this process ultimately settles will be determined by the factors influencing the long-run positions of the

aggregate supply and demand schedules, with one of the most important factors being the rate of growth of money.

The natural rate hypothesis is consistent with a Phillips curve view of inflation that includes a role for price expectations and is outlined in the upper panel of the next chart. This view, which generally is used by the staff, holds that wage increases are related to the unemployment rate and inflation expectations; and price inflation is a markup on the growth of unit costs, with the markup related to demand in product markets. Labor costs--that is, wage inflation adjusted by the trend growth of productivity--carry the heaviest weight in overall costs. As shown in the upper-left portion of the flow chart, wage inflation depends on labor market conditions (usually summarized by an unemployment rate), expected price inflation, and exogenous shocks such as changes in minimum wages and social security taxes. By combining the determinants of labor costs and the markup, this approach says that price inflation is related to expected inflation, productivity trends and the degree of tightness in both labor and product markets. In addition, factors such as food and energy shocks or large changes in the prices of imported goods can temporarily affect the aggregate inflation rate.

As shown in the lower panel, the implication of the Phillips curve view is that in the short run there is a "tradeoff" between inflation and unemployment, with the position of the short-run Phillips curve depending in part on price expectations. The higher the rate of expected inflation, the higher the position of the short-run Phillips curve--P one, two, and three in the diagram. In other words, for a given rate of unemployment, higher price expectations will be associated with higher

wage increases and therefore higher actual inflation. According to the natural rate hypothesis, however, over time the economy will tend toward output levels consistent with the natural rate of unemployment-- U_n in the diagram--with inflation primarily determined by the rate of growth of money. In terms of the diagram, in the long-run the Phillips curve becomes vertical at U_n .

As summarized on the next chart, expectations are a key element in describing the inflation process. Most empirical Phillips curves assume that expectations are formed by looking at past price performance. In contrast, the theory of rational expectations assumes that, rather than extrapolating past inflation into the future, individuals use all the currently available information, together with their knowledge of the structure of the economy and the systematic reactions of policy makers, to form "forward-looking" expectations of inflation.

The spirit of rationally-formed expectations is now accepted by most economists: in forming their expectations of inflation, individuals probably do more than mechanically extrapolate past trends. But it is our view that individuals probably are not as sophisticated in forming their expectations as the rational expectations theory assumes. However, because expectations can not be observed directly, it is important to keep in mind the sensitivity of price forecasts to the factors affecting expectations. This is a point we will be returning to later in the briefing.

The next chart summarizes the major features of the Phillips curve view of the inflation process, which forms the analytical basis of the remainder of our presentation. This approach provides a description

of the dynamics of the inflation process that allows a tracing out of the effects of policy actions on the rate of inflation. In particular, because the Phillips curve framework points to particular channels of influence, we are able to identify factors that may mitigate or amplify the impact of policy actions on inflation.

The Phillips curve view does have a role for short-run effects of money growth on inflation. But the transmission mechanism involves intermediate channels operating through interest rate effects on real economic activity. Moreover, factors other than money growth can play an important short-run role in the inflation process. Finally, the Phillips curve view takes into consideration the fact that contracts and other institutional rigidities--including government actions--can limit the flexibility of wages and prices, and as a result lead to inertia in the disinflation process.

Ms. Zickler will now continue our presentation.

One of the most important, and perhaps most controversial, of the issues involved in the Phillips curve approach to inflation is the measurement of the natural rate of unemployment--that is, the rate of unemployment associated with stable inflation. As shown in the top panel of your next chart, the staff believes that, at present, the natural rate of unemployment is in the 6 to 7 percent range. This benchmark represents the threshold of labor market tightness--other things equal--above which slack demand puts downward pressure on the rate of wage increase and below which demand would outpace supply, and wages and prices would continuously accelerate. Other ongoing developments, such as disruptions to food and energy supplies, rising import prices, or increases in payroll taxes can temporarily lead to an acceleration of inflation even though the prevailing unemployment rate is above the natural rate. These shocks shift up the short-run Phillips curve in the same manner as a rise in inflation expectations.

The natural rate of unemployment has not been stationary over time. As the chart shows, each bout of accelerating inflation--from 1964 to 1969, then from 1972 to 1974, and finally from 1976 to 1980--has been associated with a higher unemployment rate. Although price shocks may have influenced the timing of these inflation upturns, the broad pattern of movement from left to right across the page illustrates the updrift in the natural rate that occurred over the past two decades.

No doubt, a myriad of factors played some role in this rise; several major explanations are presented on the next page. The two factors that we believe are most important, and which I will discuss in

more detail, are the falloff in the trend rate of growth in labor productivity and the shift in the mix of the labor force toward less experienced workers. Changes in the structure of labor and product markets that lower economic efficiency probably played a role as well, although the impact is not easily estimated. These developments might encompass, for example, the introduction of inflexible work rules, increased mismatches of workers' skills and job requirements, and government actions--such as wage floors, protectionist trade policies, and price supports. A final contributing factor to the upward drift in the natural rate was the expansion of income support programs. These induce longer spells of unemployment by reducing the incentive to search for work and by raising the wage that jobless workers are willing to accept.

The impact of declining labor productivity growth on the natural rate of unemployment began in the late 1960s, but was most striking during the second half of the 1970s, when, as the top panel of your next chart shows, the average annual growth rate of labor productivity dropped from more than 2 percent to only about 1/2 percent.

On average, nominal wage gains only can exceed the rate of price increase by the trend rate of growth of labor productivity. In other words, over time real wages and productivity must grow at about the same rate, and during the "high productivity" years of the 1950s and 1960s, workers became accustomed to real wage increases of 2 to 3 percent a year. Following the price shocks of the early 1970s, workers continued to press for nominal wage increases that they thought would not only compensate them for the large price increases, but also keep their real wages rising

at the earlier rates, despite the sharp reduction in productivity growth. As illustrated in the middle panel, business, in turn, experienced both rapid rates of increase in hourly compensation and a shrinking offset from productivity gains. Prices were marked up over rapidly increasing unit labor costs--the gap between the two lines. As long as workers' expectations for gains in real wages were inconsistent with the lower productivity trend, upward pressure on unit labor costs and prices persisted. Accordingly, the unemployment rate required to generate enough downward pressure on wages to stabilize inflation rose considerably.

At present, the staff believes that the cyclically-adjusted trend rate of productivity growth has improved somewhat, to about 1 percent over the 1980-83 period, and this development probably has lowered slightly the natural rate of unemployment relative to the late 1970s. Looking ahead, if this improvement in the productivity growth trend were to continue, we estimate that each additional 1/2 percentage point increase in the trend would reduce the natural rate of unemployment by the same amount.

The second principal factor accounting for the uptrend in the natural rate of unemployment was the shifting demographic composition of the labor force. As shown in the top panel of the next chart, the bulk of the growth in the labor force in the 1960s and 1970s occurred among youth and women. These new entrants tended to have weaker attachments to jobs and more frequent spells of unemployment--as they first looked for work, changed jobs, or moved between school or home and the labor market. This rise in so-called frictional unemployment boosted, on balance, the measured unemployment rate associated with any given level of labor market tightness.

The effect of this trend is estimated to have added slightly more than 1/4 percentage point to the natural rate between 1954 to 1965 and another 1/2 percentage point by 1978. But with the maturation of the baby-boom generation, the flow of new workers onto the job market has slowed, taking, perhaps, 1/4 percentage point off of today's natural rate compared with the late 1970s, and some further improvement could continue through the 1980s.

The next chart summarizes our views on the responsiveness of inflation to aggregate demand. Changes in aggregate demand are reflected in changes in labor and product market conditions and have some contemporaneous impact on the size of wage settlements or the markup of prices over costs. But the full effect of such changes depends on lags in the adjustment of inflation expectations and on the inertia in wage and price-setting introduced by contracts or other institutional arrangements. Within the range of 6 to 10 percent unemployment, we believe that each additional 1 percentage point of joblessness, maintained over one year, would reduce inflation by about 1/2 to 1 percentage point.

In addition to the issue of the responsiveness of wages and prices to the level of aggregate demand, there is the question of whether rapid changes in demand could have a separate effect on inflation. This so-called "speed" effect could occur as the result of the costs of adjusting to a higher level of production--for example, rising overtime pay or a bidding up of wages or materials prices. The staff's estimates of an independent "speed" effect for aggregate wage and price measures is quite small--each 1 percentage point change in the unemployment rate over a year changes inflation by a little more than 1/4 percentage point. We should

note, however, that this effect is very difficult to isolate from other influences, such as the cyclical variation in the markup.

In addition to tracing the effects of aggregate demand on prices through the labor market and wage developments, we have looked at the relationship between capacity utilization and materials costs. The top panel of your next chart shows changes in the producer price index for intermediate materials and components for manufacturing--a broad measure of materials costs. The two shaded areas highlight episodes of rapid acceleration in these costs. The middle panel shows the unemployment rate along with the capacity utilization rate, with the shaded areas designating those periods in which the unemployment rate was below our estimate of the natural rate. As you can see, the shaded areas on both charts are closely matched. This occurs because, in both of those cycles, labor and materials markets appeared to have tightened at roughly the same rate. Thus, it is difficult to isolate any separate effect of capacity utilization on prices apart from that captured by the unemployment rate. The charts also suggest that identifying a capacity utilization "flashpoint" may be difficult. In late 1972 when materials prices began to accelerate, the operating rate for materials was in the high 80s; in 1978, these prices began to pick up with the utilization rate at around 83 percent.

A broader concern is that, as shown in the bottom table, our measures of overall capacity show a considerable slowing in growth in recent years, with actual declines in some important sectors. Indeed, to date, capacity utilization rates have been rising more quickly than during previous expansions, cautioning that supply constraints could emerge before

the unemployment rate approaches the natural rate. Several factors, however, may mitigate the implications of the capacity slowdown for inflation, including available capacity worldwide and a robust recovery in domestic capital spending.

The next chart summarizes several other factors that could lead to an acceleration of inflation even though the unemployment rate remains above the natural rate. First, government-mandated cost increases, such as hikes in payroll taxes, upward adjustments in the minimum wage, introduction of import restrictions, and higher sales or excise taxes, could contribute to higher prices. Second, large supply disturbances might raise the relative price of an important commodity; the most obvious are food and petroleum. These relative price adjustments have both a temporary direct effect on the price level and a more lasting effect on the overall rate of inflation as the shock works its way through the wage-price process. But supply shocks should not always be considered fully exogenous. Periods of rapidly rising demand--here and abroad--may have laid some of the groundwork for past oil price increases and the strength of demand for individual products may determine the extent to which commodity price shocks are passed through to final goods prices.

A third factor that could lead to higher prices is a decline in the foreign exchange value of the dollar. The impact of a fall in the value of the dollar on domestic prices is difficult to separate from other macroeconomic adjustments, which may themselves cause the dollar to change. The full effect attributable to exchange rates alone can vary depending on the factors that led to the depreciation, and there is some uncertainty

about the lag with which the effect is realized. The staff estimates that a 10 percent depreciation in the dollar, other things equal, leads to around 1-1/2 percent higher consumer prices by the end of two to three years. This estimate includes the direct effect of higher import prices, the spillover effects in raising prices of domestic goods that compete with imports, and the feedback effects on wages and other costs of higher prices and increased aggregate demand.

Finally, inflation expectations could play a role in generating an acceleration of inflation during periods of high unemployment. The chart at the bottom of the page compares an estimate of inflation expectations based on the assumption that they are some weighted average of recent experience--the heavy line--with two surveys of expected year-ahead changes in the CPI. At present, all three measures suggest that individuals anticipate that consumer prices will rise 4-1/2 to 5-1/4 percent next year. If price expectations were represented accurately by the purely backward-looking series, these expectations would continue to decelerate as long as sufficiently slack demand holds down current inflation. But if workers and firms begin to expect that prices will soon be rising more rapidly than in the recent past, these higher inflation expectations could generate pressures for higher wage settlements and larger price increases even though the economy remains below potential levels of resource utilization.

It is our belief that the primary channel of government influence on inflation is through policies affecting both the growth of aggregate demand and the path by which the economy approaches the natural

rate of unemployment. But government actions also can affect several of the factors cited on chart 13. The most obvious is the case of actions to raise costs or impede price competition. Another is related to the formation of inflation expectations. If, as we believe, inflation expectations are not entirely a simple extrapolation of past price change, but are to some extent rational or forward-looking, policymakers should be able to contribute to the information on which business and labor base their expectations.

Mr. Stockton will now discuss the outlook for inflation.

Your next chart shows the staff Greenbook projection for inflation in 1984 and a tentative first estimate for 1985. The inflation rate for the gross domestic business product price index is projected to rise from around 4-1/4 percent over the four quarters of 1983 to 5 percent in 1984 and 5-1/4 percent during 1985.

A number of factors lead us to project a small acceleration of prices in 1984, despite the fact that this second year of economic recovery still leaves considerable slack in labor markets. First, after several years of favorable food price developments, last summer's drought is expected to boost food prices next year, as current reductions in the cattle breeding stock limit meat supplies over the coming months. A second factor is the scheduled hike in social security taxes, which will raise employers' payroll costs appreciably. The projected depreciation of the dollar also will add to inflation pressures next year. Finally, the lagged effects of this year's rapid expansion of output are an additional source of price acceleration next year.

Assuming a continuation of the current recovery in real GNP into 1985 at around a 3-1/2 percent growth rate, the inflation rate would be expected to about level off. We have assumed no further shocks to food or energy prices, and no social security tax change is now planned for 1985. But the lingering influence of the dollar's depreciation in 1984, plus that of some further depreciation in 1985 would continue to exert some upward pressure on prices. This would be offset to a large extent by the projected moderate economic growth and an unemployment rate still averaging above 7-3/4 percent.

The projections for 1984 and 1985 depend on a number of factors that are subject to a great degree of uncertainty. The next table presents estimates of the inflation rate under several alternative assumptions for those factors that we consider critical to the inflation process. Foremost among these factors is the rate of economic expansion. Lines 2 and 3 illustrate the estimated effects of both stronger and weaker recoveries than currently projected by the staff. For example, the effect of a one percentage point faster growth of real output in 1984 and 1985--line 2--would be to boost projected inflation to a 5-1/4 to 5-3/4 percent pace in 1984 and a 5-3/4 to 6-1/2 percent rate during 1985; slower growth of activity would act to reduce the projected rate of inflation.

Underlying productivity trends also are important to our inflation outlook. Extracting the trend in productivity during a period of sharp cyclical swings is quite difficult; if we have been too pessimistic and the annual growth in trend productivity should prove to be closer to 2 percent, rather than 1 percent, inflation over the next two years--line 4--could be below 4 percent in 1985, other things equal.

Finally, the staff outlook is also sensitive to exchange rate developments. Line 5 presents the impact on gross domestic business product prices of assuming that the value of the dollar remains at its third-quarter 1983 level rather than falling 18 percent, as is contained in our central projection. That effect would lower projected inflation by about 1/4 of a percentage point in 1984 and by about 3/4 percentage point in 1985, relative to our baseline projection. It should be pointed out that this effect appears small because the GBP fixed-weighted price index

only measures the effects of exchange rate movements on the prices of domestically-produced goods. In contrast, the downward effect on the level of the consumer price index, which includes both domestically-produced and imported goods, would be about twice as large.

Of course, the risks we have cited are not necessarily independent. Stronger growth would not only raise the inflation path, but also increase the likelihood of unfavorable developments for food, energy, and import prices. Slower growth, in contrast, would enhance the probability of weaker food and energy prices and a stronger dollar. On balance, however, given our current projections of the underlying determinants of price inflation, the Phillips curve view of inflation used by the staff would call for a small acceleration of prices over the next 2 years.

In contrast to the staff projection, inflation forecasts using typical monetarist equations--shown on your next table--currently show a 7-1/2 to 8-3/4 percent rate of price increase over the four quarters of 1984. Assuming that the growth of M1 slows by 1/2 percentage point in 1985 from the mid-point of the 1984 range, the inflation rate projected by these equations falls in the 6-1/2 to 10 percent range in 1985. These results are quite different from the staff forecast, and in our view would only be likely to occur if real growth in 1984 and 1985 were to be substantially stronger than expected, averaging at least 7 percent per year.

The next chart shows the out-of-sample forecast performance of two versions of a monetarist equation; one assumes prices respond fully to money growth in two years, while the other uses a four-year adjustment period. For comparison, we also have included the out-of-sample forecasts of a typical

Phillips curve equation. Any exercise of this nature is always sensitive to the precise specifications used and, therefore, the results should be viewed only as broadly representative of the forecasting performance of these models. A general feature of both the monetarist equations and the Phillips curve was a tendency to under-predict inflation in 1980 and 1981. However, over the past two years the monetarist equations have over-predicted inflation by a wide margin. The Phillips curve, on the other hand, has remained closer to the actual path of inflation in 1982 and 1983.

The next table presents some information on the longer-run outlook. The staff has examined paths of real output and unemployment, using the Board's quarterly econometric model, that we feel would be capable of achieving price stability within 5 years. In this exercise, we assumed that, beginning in 1984, monetary policy is adjusted to place unemployment on a path capable of reducing inflation to near zero by 1988. Furthermore, this adjustment is assumed to be implemented quickly enough to reduce the growth of real output in 1984, as well as limit the projected decline in dollar exchange rates. Second, fiscal actions are assumed that reduce the structural deficit by \$120 billion by 1988. Third, it was assumed that the current trend productivity growth--a bit over 1 percent at an annual rate--continues over the five-year horizon. Finally, no food or energy price shocks are assumed.

The first thing to note is that, using the baseline assumptions, the Board's model indicates that reaching price stability by 1988 would require persistently low rates of economic growth over the five-year horizon. The unemployment rate--line 1--would remain near its current level, ending 1984

at 8-1/2 percent and staying in the 8-1/2 to 9 percent range through 1988. In other words, to overcome the inertia still existing in current inflation, including some reversal of the dollar's recent appreciation, the unemployment rate must remain significantly above the natural rate throughout the entire five-year period.

The baseline case is only meant to be illustrative and the specific results are dependent on the set of assumptions we have outlined above, as well as the structure the quarterly model. Changes in any of these assumption would alter the path of unemployment associated with achieving price stability. For example, should the dollar's depreciation, for exogenous reasons, be sharper than was projected in the baseline case, a higher unemployment path would be needed in order to offset the inflationary influence of the lower dollar. Likewise, any unfavorable shocks to food or energy prices during this period would also require slower growth and higher unemployment in order to limit price increases in other sectors of the economy.

On the more favorable side, an improvement in trend productivity would reduce the costs of reaching zero inflation. By lowering producers' costs for a given increase in nominal wages, higher productivity growth would allow a reduction in the rate of inflation to occur at lower unemployment rates. If the rate of trend productivity growth should be 2 percent over the period, the unemployment path necessary to achieve price stability could be about 1 percentage point less than in the baseline case. The task of achieving price stability in five years also would be made easier

if federal, state and local governments systematically removed regulations and altered policies that artificially boost costs and prices.

Finally, the results for both the near-term outlook and the longer-run horizon are based on the structural elements of the inflation process that can be quantified for forecasting purposes. Price expectations and the psychology of inflation do not fall easily into this category, but as indicated earlier, these are critical factors in wage and price determination. To the extent that credible public policies could help reduce inflation expectations, the adjustment to lower rates of inflation would be faster and achieved at a lower cost of lost output.